

# Acute coronary syndrome in pregnancy

# Physiological changes in pregnancy

- **Hemodynamic:**

- Increased blood volume → 20-100%
- Increased cardiac output → 30-50%

Onset      6<sup>th</sup> week

Peak        early postpartum

Back to normal      1-3 days

*Robson SC, et al. Am J Physiol 1989;256:H1060-5.*

# Physiological changes in pregnancy

## • Vascular wall:

- Smooth muscle relaxation
- Impaired collagen synthesis
- Degenerative arterial wall changes:
  - Loss of normal corrugation of elastic fibers.
  - Fragmentation of reticular fibers.
  - Decrease in acid mucopolysaccharide
  - Collagenolysis – increased eosinophil count

*Bucciarelli E, et al. Pathol Res Pract 1998;194:137-9.*

*Bonnet J, et al. Eur Heart J 1986;7:904-9.*

# Physiological changes in pregnancy

- **Hypercoagulation state**
  - Reduced anticoagulation factors:
    - ↓ protein S
    - ↓ protein C
  - Enhanced coagulation
    - ↑ fibrinogen
    - ↑ platelet adhesion and aggregation
    - ↑ factor VII, VIII, X
    - ↑ PAI-1

# Acute myocardial infarction

—most common ACS in pregnancy

- Incidence:

1/10,000 to 1/35,000 pregnancies

- An increase of incidence:

1991: 1 in 73,400 pregnancies

2000: 1 in 24,600 pregnancies

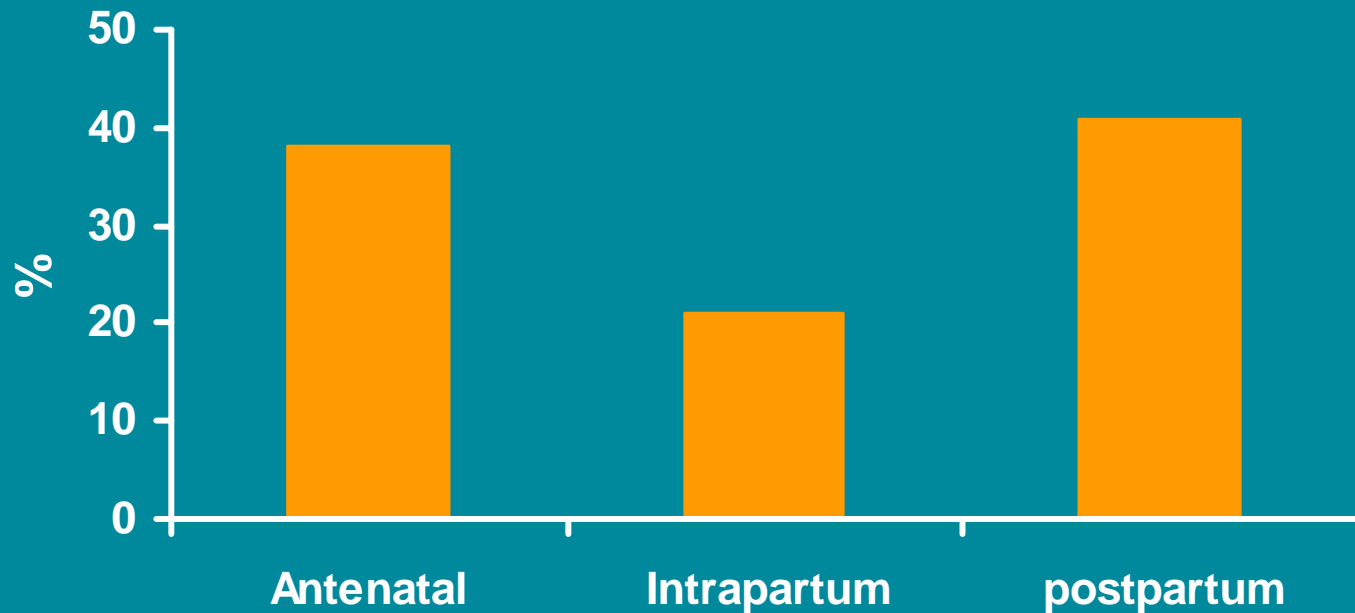
*Ladner et al. Obstet and gynecol 2005;105:480*

# AMI

## -periods of pregnancy

- >2/3 in the third trimester

*Roth and Elkayam Ann Intern Med 1996;125:751*  
*Hankins et al. Obstet Gynecol 1985;65:139*

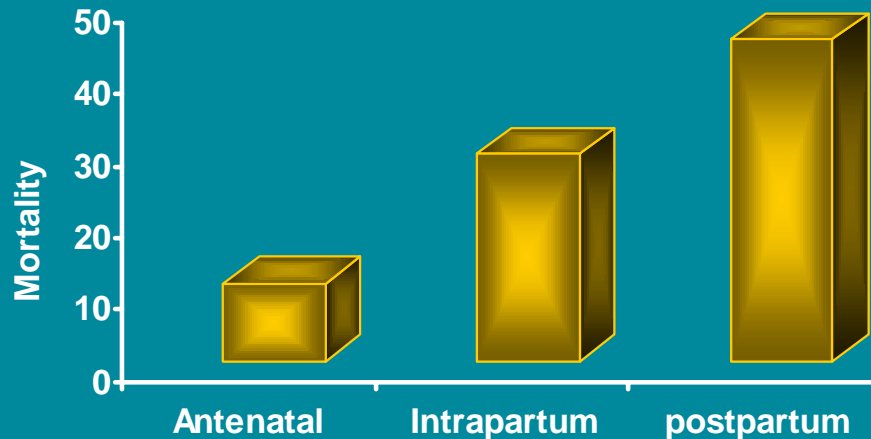


*Ladner et al. Obstet and gynecol 2005;105:480*

# Maternal mortality

→ previous collective analysis

- Overall 21-37%
- IDDM 50%
- Mortality vs. period of pregnancy:



*Hankins et al. Obstet Gynecol 1985;65:139*

# Fetal mortality

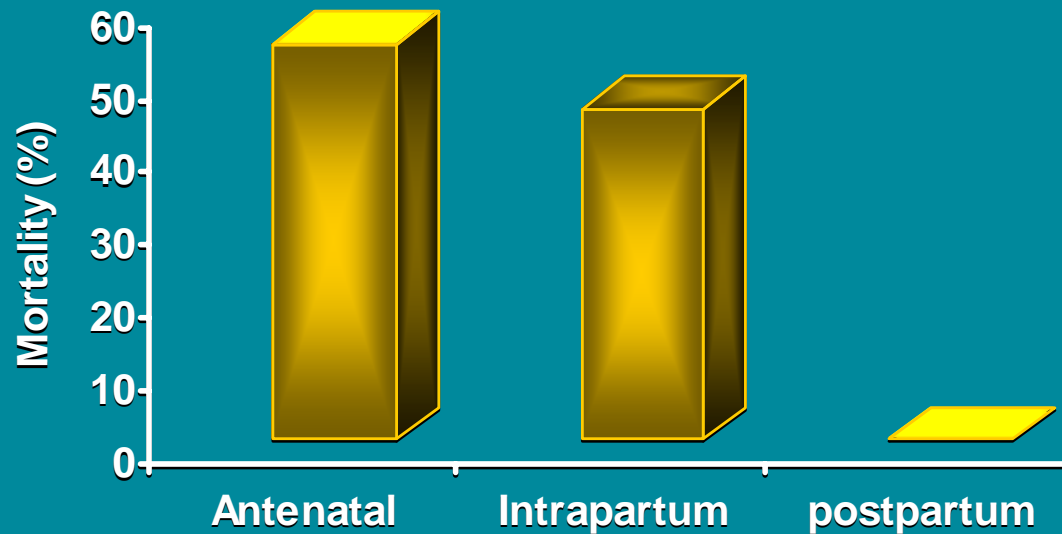
13-34%

*Hankins et al. Obstet Gynecol 1985;65:139*

# Maternal mortality

→ recent 10-year population based report

- Overall mortality: 7.3% (vs. 0.02% in non-AMI)
- Mortality vs. period of pregnancy:



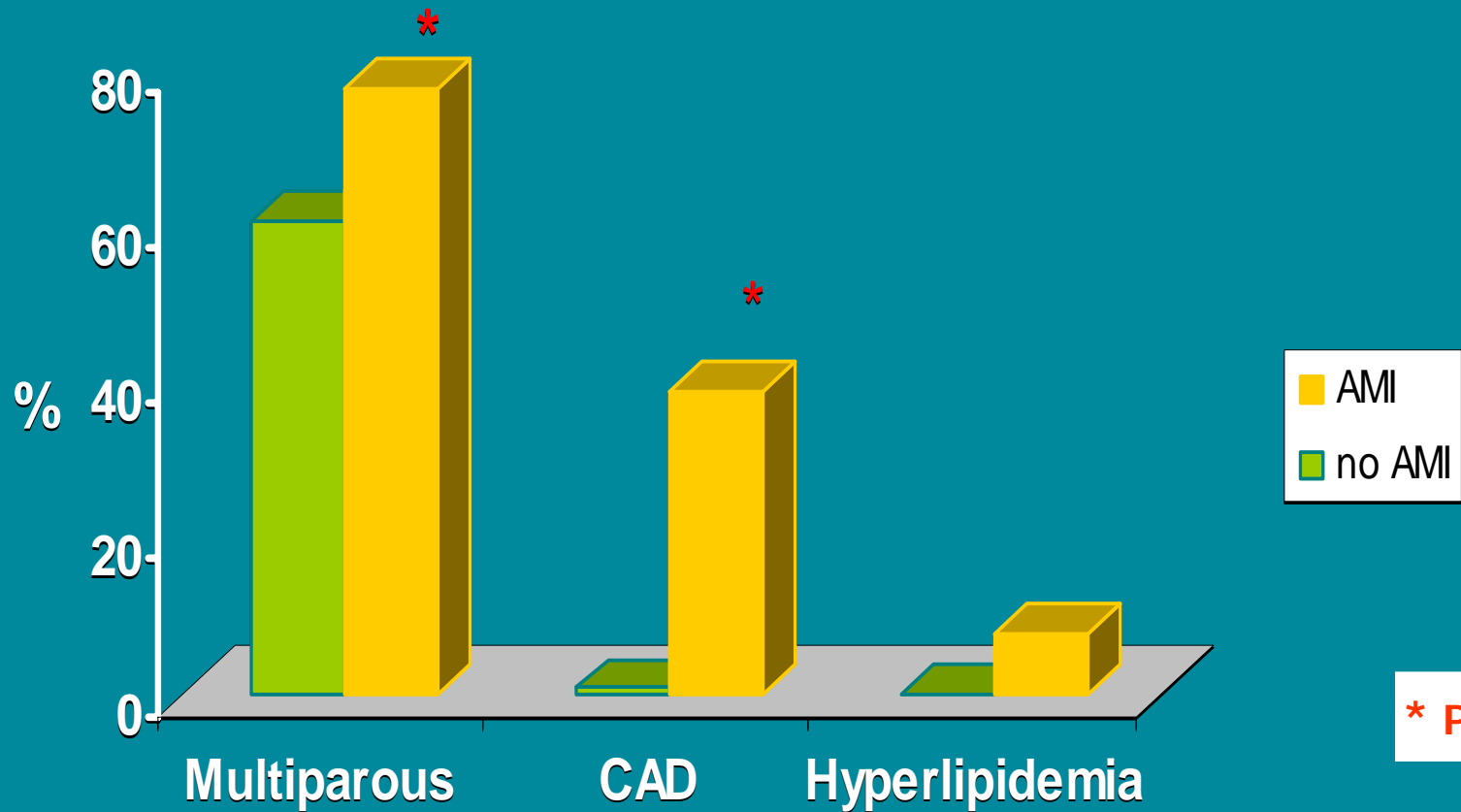
*Ladner et al. Obstet and gynecol 2005;105:480*

# Independent risk factors

*Ladner et al. Obstet and gynecol 2005;105:480*

	OR	95% CI
Age (vs 21-25yrs):		
30-35	2.6	1.6-4.5
35-40	3.4	1.9-6.0
>40	4.5	2.0-9.8
Diabetes	4.3	2.3-7.9
Chronic hypertension	24.5	14.8-40.3
Eclampsia	15.3	5.3-44.1
Severe eclampsia	6.9	3.7-13.1

# Other risk factors

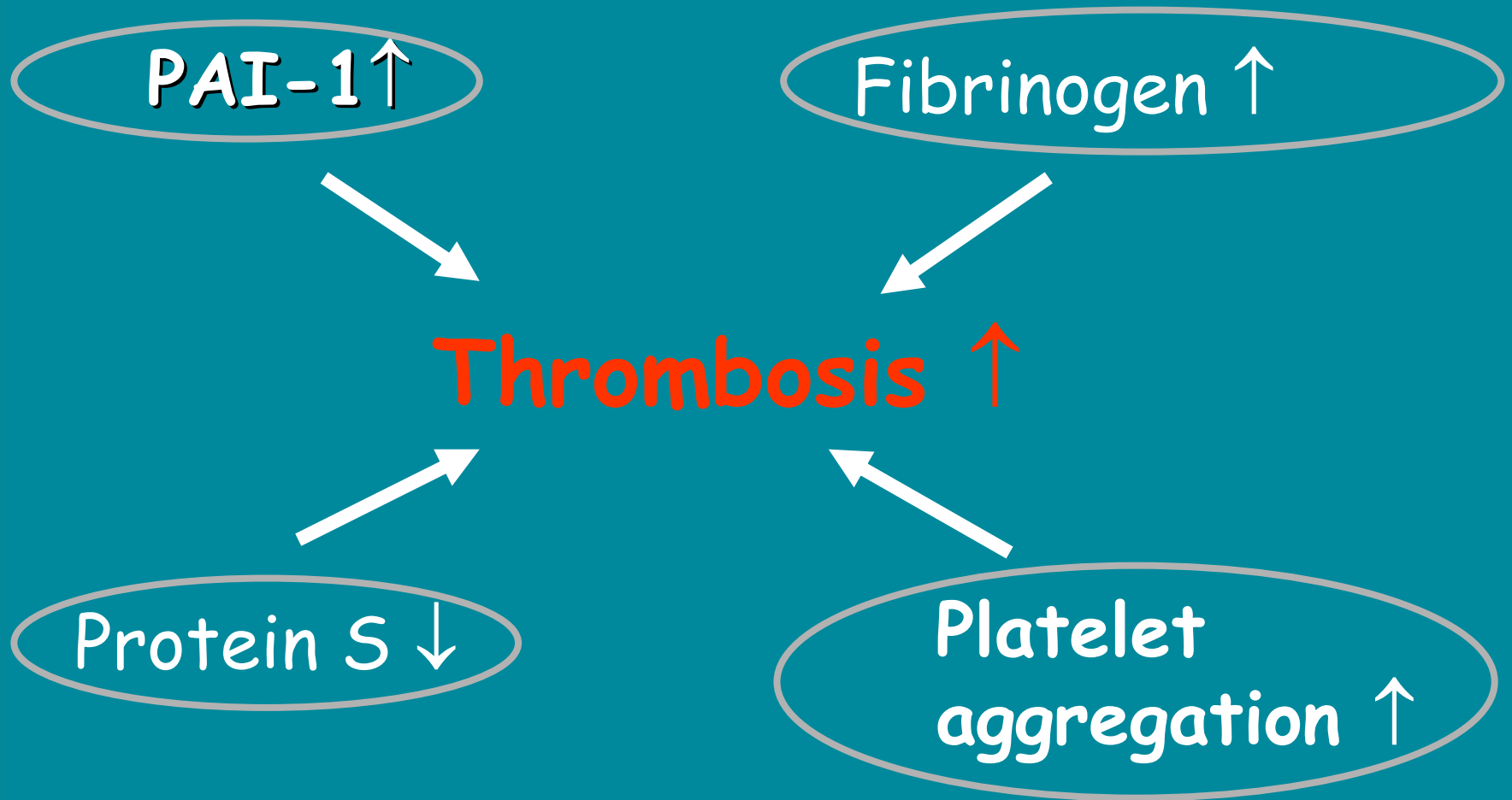


*Ladner et al. Obstet and gynecol 2005;105:480*

# Pathophysiology

- Coronary thrombosis
- Coronary spasm
- Coronary dissection
- Myocardial O<sub>2</sub> demand/supply mismatch

# Pathophysiology-thrombosis



# Pathophysiology-spasm ↑

- Endothelial dysfunction
- Increased renin and angiotensin production
- Enhanced vascular reactivity to angiotensin II and norepinephrine
- Ergot derivatives use

# Pathophysiology-dissection

## Pathological findings

- Mostly in LAD in postpartum
- Intramural hematoma
- Degenerative arterial wall changes
- Eosinophilic infiltration
- Intimal tearing

*Borczuk et al. Cardiovasc Res 1997;33:527-32.  
Bonnet J, et al. Eur Heart J 1986;7:904-9*

# Angiographic findings

- Atherosclerosis ( $\pm$  thrombus)  $\rightarrow$  39-43%
- Thrombus (w/o atherosclerosis)  $\rightarrow$  21%
- Coronary dissection  $\rightarrow$  16%
- Normal coronary  $\rightarrow$  29%

*Roth and Elkayam Ann Intern Med 1996;125:751  
Badui and Enciso. Angiology 1996;47:739-56*

# Pregnancy periods

- Atherosclerosis → Antepartum (58%)
- Normal coronary → Peripartum (75%)
- Coronary dissection → Postpartum (33%)

*Roth and Elkayam Ann Intern Med 1996;125:751*

# Diagnostic problems

- ECG:  
ST depression common in cesarean section (37%)
- Blood enzymes:  
CK & CK-MB: not reliable after delivery  
(troponin I reliable)
- Coronary angiography  
avoid in 1<sup>st</sup> trimester

*Burton and Camann Int J Obstet Anesth 1996;5:47-53*

## Strategies for AMI with CAD

- CAD prior to AMI: 7-13%
- Risk factors: smoking, toxemia, hyperlipidemia, DM, family history of CAD
- Treatment:
  - PCI:
    - Relative contraindication →  
10-50 days of pregnancy
    - Best time → second trimester
    - Notice → Shielding; upper limb approach

*ESC guidelines. European Heart J 2003;24:761-81*

# Strategies for AMI without pre-diagnosed CAD

- Diagnosis: coronary angiography
- Treatment:
  - PCI (Shielding; upper limb approach)
  - CABG:
    - extensive dissection
    - Kawasaki disease with aneurysm formation and thrombosis

*ESC guidelines. European Heart J 2003;24:761-81*

# Pharmacological strategies for AMI in pregnancy

- Aspirin:
  - <150mg/d in 2<sup>nd</sup> and 3<sup>rd</sup> trimester → safe
  - >200mg or in 1<sup>st</sup> trimester → controversial
- Nitrates:
  - avoid hypotension
- Morphine:
  - neonatal respiratory depression → avoid before delivery

*ESC guidelines. European Heart J 2003;24:761-81*

# Pharmacological strategies for AMI in pregnancy

- **$\beta$  blockers:**  
recommend:  $\beta$ 1 blockers  
avoid bradycardia and hypotension
- **Calcium antagonist:**  
recommend: Nifedipine  
avoid hypotension  
(Diltiazem teratogenic, verapamil with caution)

*Braunwald's Heart Disease 7<sup>th</sup> edition  
Roth and Elkayam Ann Intern Med 1996;125:751*

# Pharmacological strategies for AMI in pregnancy

- Heparin

recommend: regular heparin

avoid: <24h cesarean /during spontaneous delivery

*Braunwald's Heart Disease 7<sup>th</sup> edition  
Roth and Elkayam Ann Intern Med 1996;125:751*

# AMI in pregnancy

## Contraindicated strategies

- Thrombolysis
- ACEI: teratogenic
- Statins: teratogenic
- Sodium nitroprusside: teratogenic
- Lack of experience:
  - Dobutamine
  - Low molecular heparin
  - Clopidogrel
  - IIb/IIIa antagonists

*ESC guidelines. European Heart J 2003;24:761-81*

# Treatment for complications

## → Congestive heart failure

- Diuretics: avoid hypotension
- Nitrates: avoid hypotension
- Morphine: avoid before delivery
- Digoxin
- Limited experience:
  - IABP → one successful case
  - Dopamine; Dobutamine
- Contraindication
  - ACEI; Sodium nitroprusside

*ESC guidelines. European Heart J 2003;24:761-81  
Braunwald's Heart Disease 7<sup>th</sup> edition*

# Treatment for complications

## → Anti-arrhythmic medication

- **Approved**
  - $\beta$ 1 blockers; Digoxin; Adenosine; Quinidine
- **Controversial**
  - Amiodarone
- **Caution with drug level**
  - Lidocaine, Procainamide
- **Not recommended**
  - Sotalol; Verapamil

*ESC guidelines. European Heart J 2003;24:761-81  
Braunwald's Heart Disease 7<sup>th</sup> edition*

# Pharmacological strategies for breast feeding mother

- Possible choice:  
aspirin (<150mg/d); ACEI; calcium antagonists;
- Contraindication: beta-blockers  
amiodarone

*ESC guidelines. European Heart J 2003;24:761-81  
Braunwald's Heart Disease 7<sup>th</sup> edition*

# Pregnancy complications and subsequent maternal CAD

Complication	Relative risk
• Pre-eclampsia	2.0-8.3
• Low birth weight	7.1-11.3
• Preterm delivery	1.8-2.1

*Lancet 2001;357:2002-6; Am J Cardiol 2004;93:805-8;  
Lancet 2000;356:2066-7; BMJ 2000;320:839-40.*

# Summary

- Epidemiology: rare, but increasing
- Increased maternal mortality mainly before and during labor
- Main risk factors: older age, diabetes, hypertension, eclampsia
- Main pathology: thrombosis, spasm & dissection
- Diagnosis: coronary angiography
- Treatment: PCI